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## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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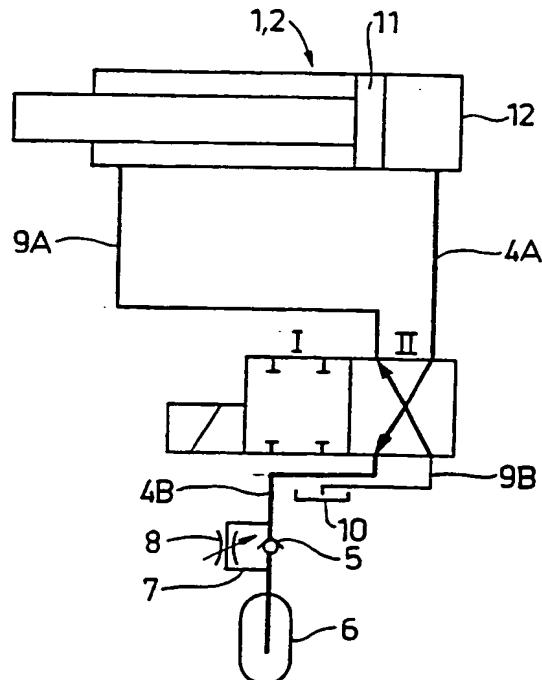
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## (54) Title: SHOCK ABSORBING DEVICE FOR A MOBILE MACHINE



## (57) Abstract

This invention relates to a device for mobile machines, preferably wheel-borne loading machines, which comprise a loading unit being vertically adjustable by means of at least one hydraulic cylinder which is an integral part of a hydraulic system in the machine. According to the invention the device is intended to cooperate with the loading unit in such a way that movements of swinging of the machine are damped, and the device is connected to the hydraulic system (1, 2) of the machine.

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### Shock Absorbing Device for a Mobile Machine

This invention relates to a device for mobile machines, preferably wheel-borne loading machines, comprising a loading unit which is vertically adjustable by means of at least one hydraulic cylinder, being an integral part of a hydraulic system in the machine.

5                    Wheel-borne loading machines are common in the market. These machines as a rule have a loading unit provided with 10 hydraulic cylinders and comprising for instance forks or a bucket by means of which it is possible to load or unload goods and to move goods between two points. In the later case this 15 transport of goods may involve transportation a long distance along a bumpy road. Therewith there arise strong swingings in the machine if this one should drive into a pit. These swingings become stronger if the loading unit carries a load of any kind. Since the lifting cylinders of the loading unit during 20 transportation on a road are locked in a certain position, there arise strong loads on the loading unit when the machine drives into a pit, which loads are directly transmitted to the 25 chassis of the loading machine and therefrom to the wheels of the loading machine. The result will be a very bad riding comfort for the driver of the loading machine, strains on the loading machine and its loading unit and large stresses on the tyres of the loading machine. Thus, when the driver of the 30 machine happens to drive into a pit with the result that the machine comes into swingings, he must immediately reduce the velocity strongly in order that the swinging shall be reduced.

35                    This invention intends to remove the problems with known technique. This has been made possible by a device of the kind mentioned by way of introduction, which is characterized in that it is intended to cooperate with the loading unit in such a way that the movements of swinging of the machine are damped, and that the device is connected with the hydraulic system of the machine. Due to that fact the uncomfortable movements of swinging of the machine are substantially eliminated, whereby the comfort for the driver increases and the stresses on the machine and on the loading unit are reduced. Moreover, the life-length of the tyres increases evidently. The remaining features of the invention will appear more closely below.

A preferred embodiment of the invention shall be described more closely with reference to the accompanying drawings, where Fig. 1 shows a connection diagram for a hydraulic system in an existing loading machine; Fig. 2 shows a connection diagram for a device according to the invention in that moment when an extra load is applied onto the loading unit of a loading machine; Fig. 3 shows the connection diagram according to Fig. 2 in the moment afterwards and Fig. 4 shows an electrically controlled magnetic valve for regulation of the device according to the invention.

Referring to Fig. 1 is there shown a connection diagram for a hydraulic system in a loading machine being in the market. Therewith two hydraulic cylinders 1, 2 are shown, which are used as lifting cylinders for the loading unit of the loading machine. These hydraulic cylinders have connection with a direction valve 3.

The device according to the invention for dampening movements of swinging of the loading machine is intended to be able to be arranged in the hydraulic system of both new and existing loading machines. Therewith the device is connected with the hydraulic system between the hydraulic cylinders 1, 2 and the direction valve 3. The device according to the invention is intended to admit a certain damped movement of the loading unit in relation to the chassis of the loading machine, when the machine transports goods on a road. Thus, the loading unit is not locked in a certain position during transportation as in conventional loading machines. This movement of the loading unit in relation to the chassis of the loading machine is accordingly achieved by means of the device shown in Figs. 2-4.

The device comprises a conduit 4A, B, which is connected to the pressure side of the hydraulic cylinders 1, 2. This conduit is via a non-return valve 5 connected to an accumulator 6 which may comprise a membrane pressure chamber or a cylinder in which a plunger is movably arranged. Therewith the cylinder is closed so that there is a space in front of and behind, respectively, the plunger. In the space in front of the plunger hydraulic oil is intended to be pressed into and out of the cylinder, while a gas, preferably nitrogen gas, is intended to be compressed and to expand, respectively, in the space be-

hind the plunger. At the non-return valve 5 there is arranged a by-pass conduit 7 in which a throttle valve 8 is arranged. This valve is adjustable with regard to operation conditions and type of loading machine. The device further comprises a conduit 9A, B, which is connected to the suction side of the hydraulic cylinders 1, 2, and which has connection with the hydraulic tank 10 of the hydraulic system.

In Fig. 2 is shown what is happening if there arises an extra load on the loading unit of a loading machine, provided with goods, for instance if the loading machine drives into a pit when driving on a road. Therewith the loading unit is temporarily lowered which has the consequence that the plunger 11 is pressed further into the cylinder house 12 of the hydraulic cylinders 1, 2 resulting in that hydraulic oil is pressed via the conduit 4A, B and the non-return valve 5 into the accumulator 6 in the space in front of the plunger or the membrane, whereby the pressure increases in the accumulator behind the membrane or the plunger. At the same time hydraulic oil is sucked from the hydraulic tank 10 via the conduit 9A, B into the hydraulic cylinders 1, 2 on the rear side of the plunger 11. In the next moment, that is when the extra load has temporarily ceased on the loading unit of the loading machine, oil is pressed back from the accumulator 6 via the throttle valve 8 and the conduit 4A, B to the hydraulic cylinders 1, 2, which has the consequence that the plunger 11 is pressed back in the cylinder 12 resulting in that the loading unit of the loading machine is raised to its normal position. Since hydraulic oil in the former moment is sucked into the rear side of the plunger 11, this movement backwards is made against the pressure of the oil being behind the plunger 11, which is accordingly pressed back to the hydraulic oil tank 10 via the conduit 9A, B. Therefore the movement backwards of the plunger 11 is made by a reduced velocity, which has the consequence that the raising of the loading unit of the loading machine is made softly and smoothly. Due to that fact the swinging of the machine immediately ceases after the machine has been driven into a pit.

In Fig. 4 is shown a further developed device according to the present invention. This device comprises an electrically

controlled magnetic valve 13 for connecting the dampening device and disconnecting the same, because this one needs not to be connected during loading and unloading of goods but preferably only when driving the loading machine on a road with a load on the loading unit.

In Figs. 2 and 3 is accordingly shown the magnet valve 13 in position II which applies when the dampening device is connected. Therewith the conduit 4A, which extends from the pressure side of the hydraulic cylinders 1, 2 to the magnet valve 13, is via this one connected with the line 4B, which extends from the magnet valve to the accumulator 6, while the conduit 9A, which extends from the suction side of the hydraulic cylinders to the magnet valve 13, via this one is connected with the conduit 9B, which extends from the magnet valve 13 to the hydraulic oil tank 10.

If the driver of the machine now wants to disconnect the dampening device, he pushes a button in the machine, whereby the electrically controlled magnet valve 13 takes the position I, see Fig. 4. Therewith the connection between the conduits 4A and 4B on one hand and between 9A and 9B on the other hand is broken, whereby the loading machine provided with the device patent applied for functions as a conventional loading machine. If there is a desire again to connect the dampening device, the button is again pushed in, whereby the magnet valve takes the position II.

In the application wheel-borne loading machines have been described. Of course, the invention can be applied onto other types of loading machines and loading cranes.

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Claims

1. A device for mobile machines, preferably wheel-borne loading machines, which comprise a loading unit which is vertically adjustable by means of at least one hydraulic cylinder being an integral part of a hydraulic system in the machine, characterized in that the device is intended to cooperate with the loading unit in such a way that movements of swinging of the machine are damped, and that the device is connected to the hydraulic system (1, 2) of the machine.

5 2. A device according to claim 1, the hydraulic system comprising two hydraulic cylinders (1, 2) which function as lifting cylinders, and a direction valve (3), characterized in that the device is connected to the system between the hydraulic cylinders (1, 2) and the direction valve (3).

15 3. A device according to claim 1 or 2, characterized in that it comprises an accumulator (6), which is connected to the pressure side of the hydraulic cylinders (1, 2) via conduits (4A, B).

20 4. A device according to claim 3, characterized in that the accumulator comprises a membrane pressure chamber (6).

25 5. A device according to claim 3, characterized in that the accumulator comprises a plunger cylinder (6).

30 6. A device according to claim 5, the cylinder (6) being closed and a space being arranged in front of and behind, respectively, the plunger, characterized in that hydraulic oil is intended to be pressed into and out of the cylinder (6) in the space in front of the plunger, and that a gas is intended to be compressed and to expand, respectively, in the space of the cylinder (6) behind the plunger.

35 7. A device according to claim 8, characterized in that a non-return valve (5) is arranged in the conduit (4A, B), and that a throttle valve (8) is arranged in a conduit (7) passing the non-return valve (5).

8. A device according to any one of the claims 2-7, characterized in that it comprises a conduit

(9A, B) extending between the suction side of the hydraulic cylinders (1, 2) and a hydraulic oil tank (10).

9. A device according to claim 8, characterized in that an electrically controlled magnetic valve (13) having two positions (I, II) is connected to the conduit (4A, B) between the hydraulic cylinder (1, 2) and the non-return valve (5) and to the conduit (9A, B), and that in one position (II) the magnetic valve (13) is arranged to connect the conduit (4A) with (4B) and the conduit (9A) with (9B), respectively, while the magnetic valve in its other position (I) is arranged to break the connection between the conduit (4A) and (4B) on one hand and the conduit (9A) and (9B) on the other hand.

10. A device according to claim 6, characterized in that the gas in the accumulator (6) is nitrogen gas.

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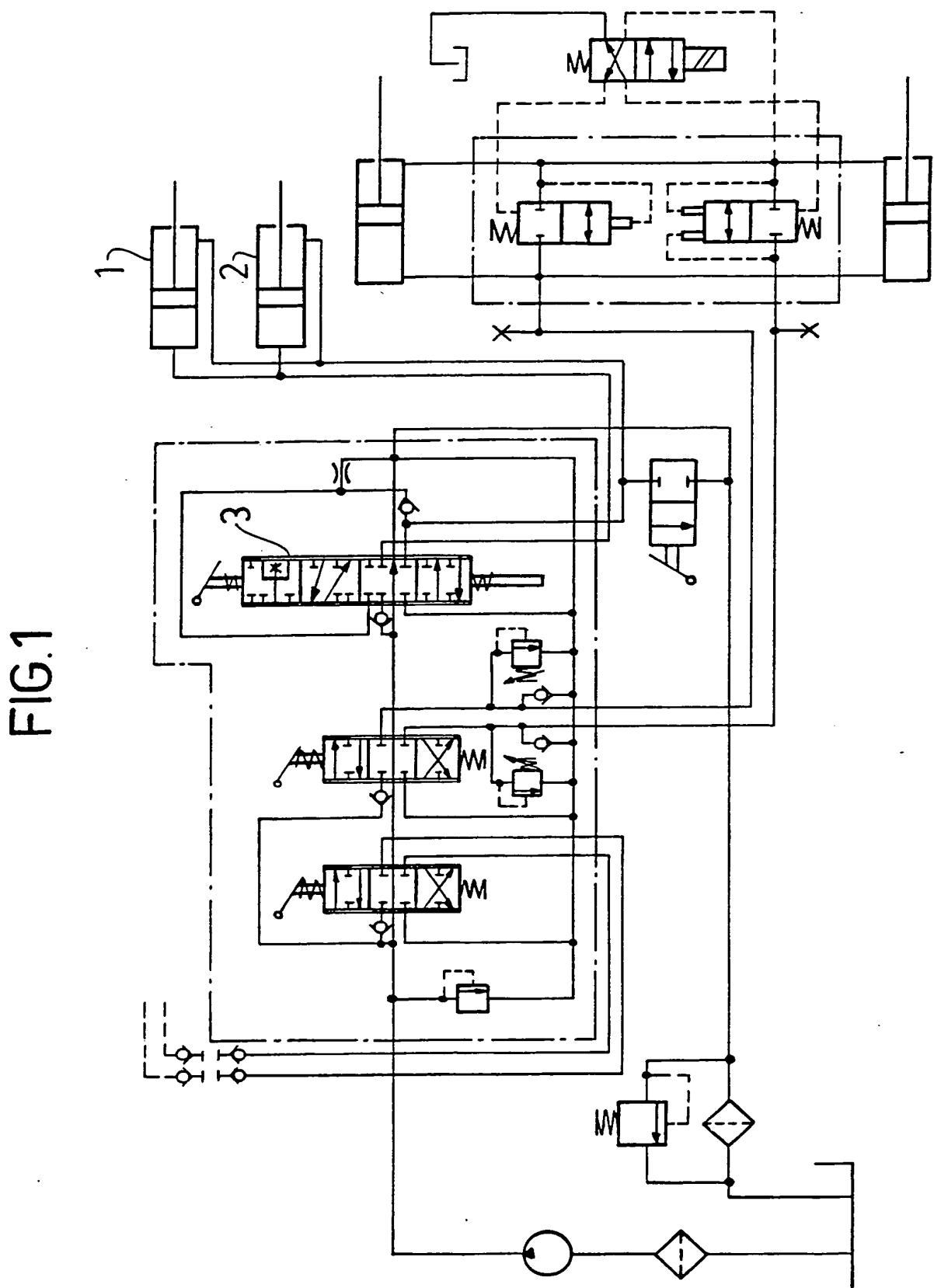


FIG.2

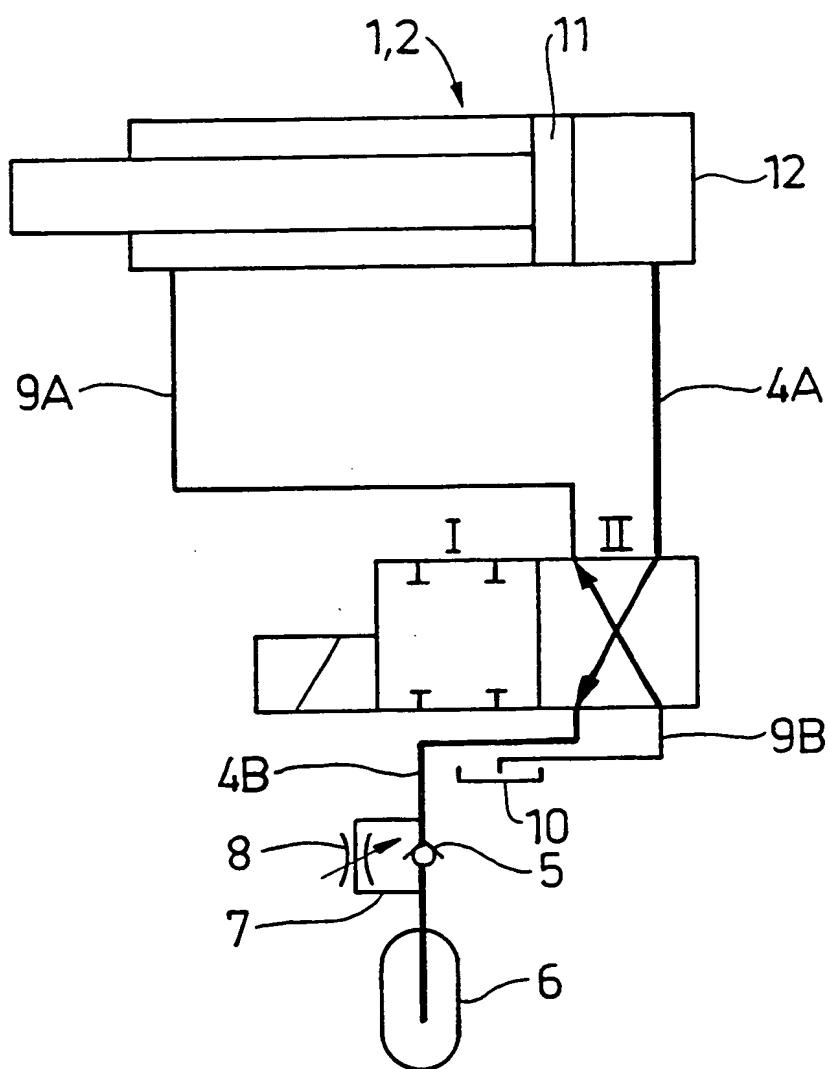


FIG.3

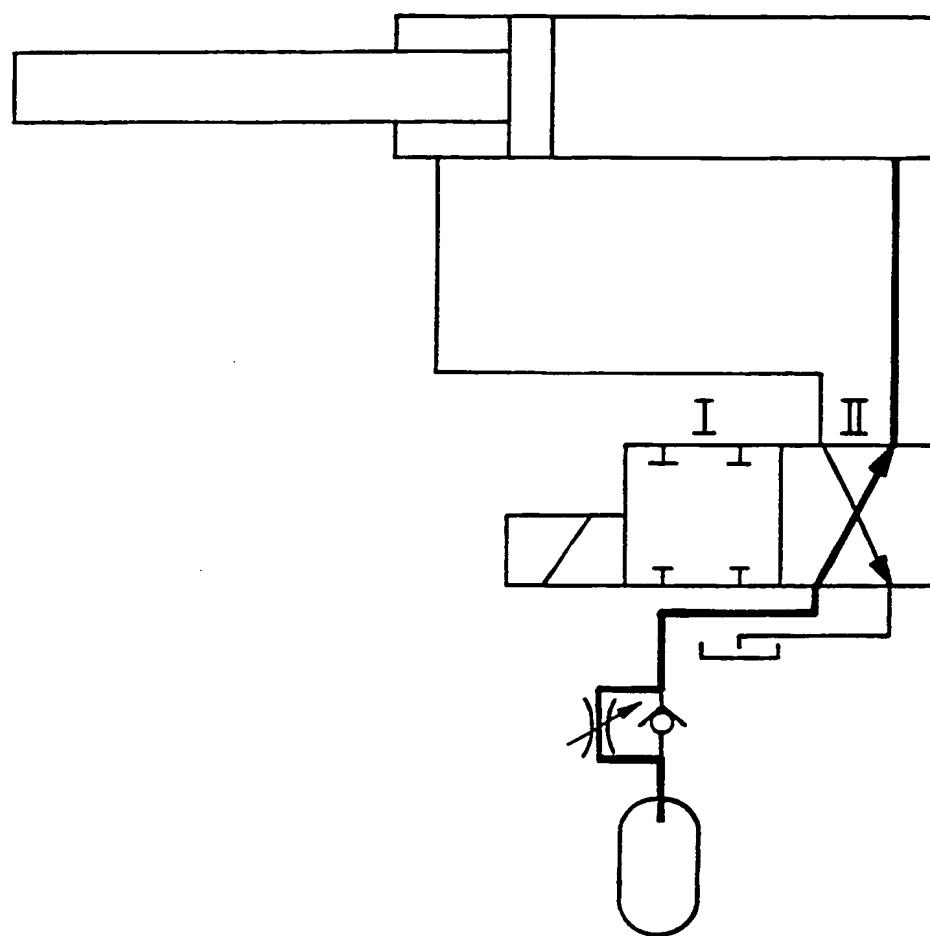
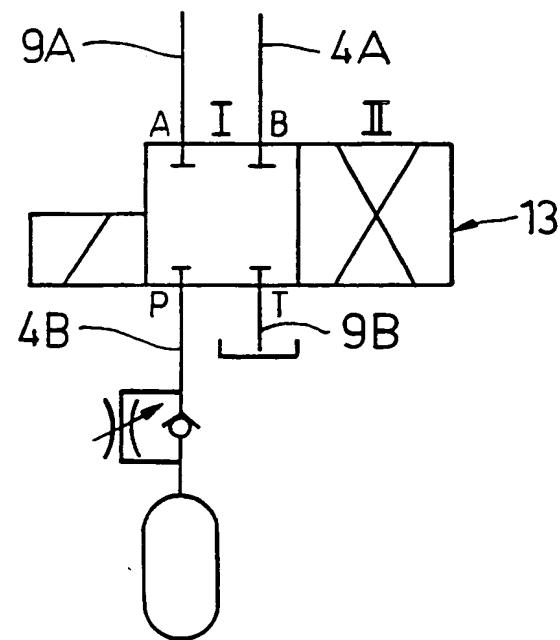


FIG.4



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# INTERNATIONAL SEARCH REPORT

International Application No. PCT/SE88/00639

## I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) \*

According to International Patent Classification (IPC) or to both National Classification and IPC

4

E 02 F 3/42, 9/20, F 15 B 21/00

## II. FIELDS SEARCHED

Minimum Documentation Searched \*

Classification System	Classification Symbols
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## III. DOCUMENTS CONSIDERED TO BE RELEVANT \*

Category *	Citation of Document, <sup>11</sup> with indication, where appropriate, of the relevant passages <sup>12</sup>	Relevant to Claim No. <sup>13</sup>
X	GB, A, 1 092 631 (DOWTY HYDRAULIC UNITS LTD) 29 November 1967 page 1, lines 12-30; page 2, lines 32-92	1,2,3,5 4,6,10
Y	US, A, 3 779 017 (FUJISAWA ET AL) 18 December 1973 column 1, lines 20-25; column 3, lines 24-26; column 4, lines 17-44; fig 3 & DE, 2245485	4,10
X	US, A, 3 872 670 (DEZELAN ET AL) 25 March 1975 column 3, lines 35-43 & BE, 814490 GB, 1421878 AU, 68448/74 CA, 1001927 JP, 50013785 JP, 57047047	1,2,3,4 10
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## IV. CERTIFICATION

Date of the Actual Completion of the International Search

1989-07-05

Date of Mailing of this International Search Report

1989-07-07

International Searching Authority

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## III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

Category *	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No
Y	SE, C, 207 732 (E K P GRAHAM) 27 September 1966 accumulator 24	6
X	DE, B2, 2 910 434 (LICENTIA PATENT-VERWALTUNGS-GMBH) 14 May 1981 column 3, line 52 - column 4, line 53	1,2,3,5
X	DE, A1, 3 316 085 (HANOMAG GMBH) 8 November 1984 page 9, last paragraph - page 11 first paragraph	1,2,3,4